WineEng 2018 – 25 July, Nuriootpa, SA

The Australian Wine Research Institute

Trends in wine production technology & future challenges

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AWRI Vineyard & Winery Practices Survey 2016

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Purpose

- Track trends in wine industry practices

Status

- Aggregated and plotted data
- Visited ~50 producers and suppliers to discuss data and understand context
- Working on the final report currently
- Preliminary data used in presentation today

Vineyard Practices

Winery Practices

464 responses	227 responses
26,000 ha	1.3 million t
(19% ha, 9% n)	(74% t, 47% n)

Cross-flow filtration – most important practice change

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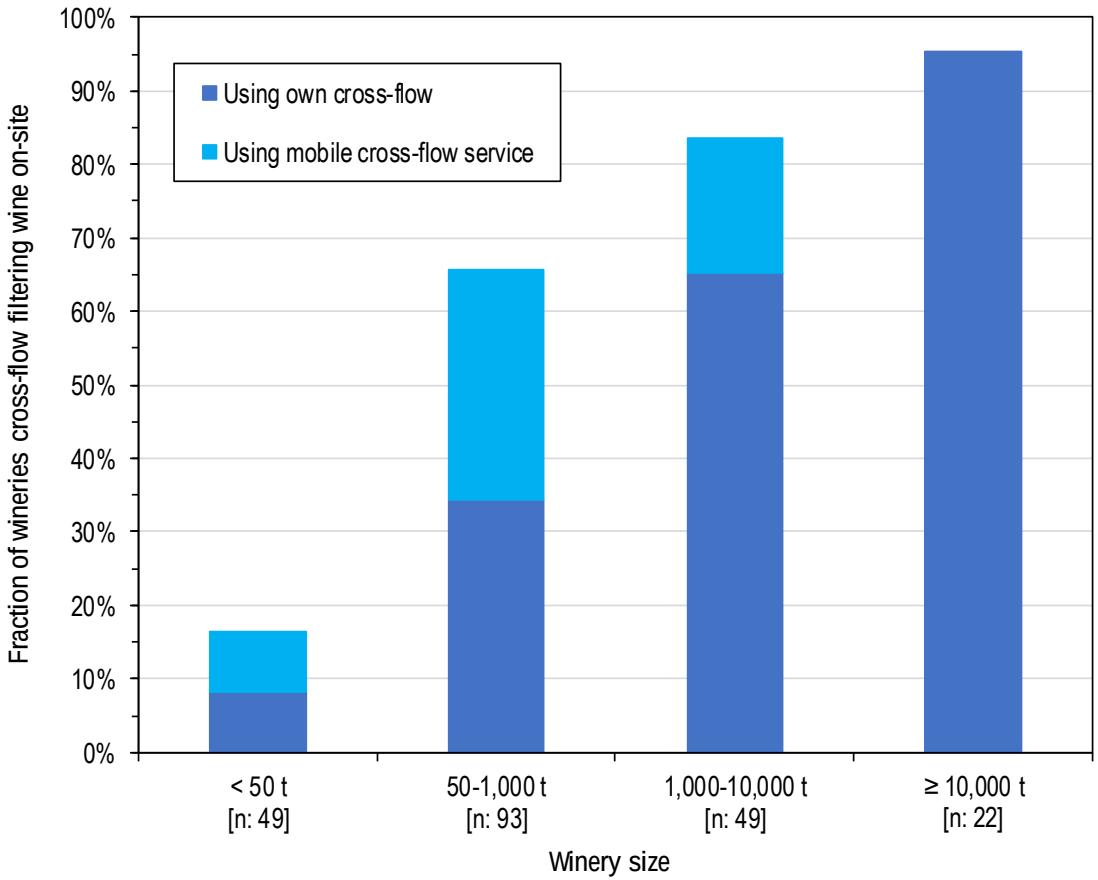

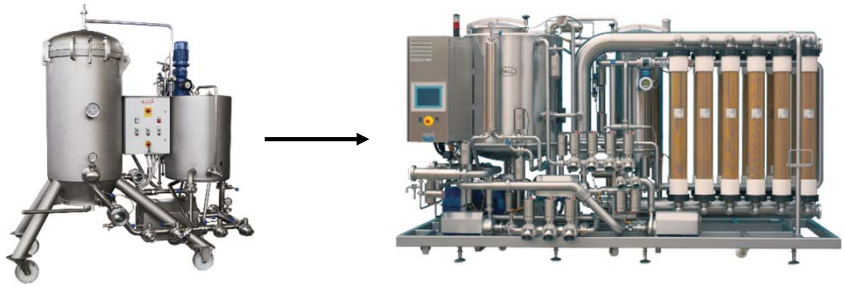

*"The biggest single advance we have made in **quality improvement** in the last 25 years"*

- Eliminates diatomaceous earth (DE) - OHS & disposal
- Reduced number of filtration stages
- Automation:
  - Can run for long periods unsupervised – night, etc.
- Praised by most but not everyone
  - Expensive to purchase & to replace membranes
  - Low flow rates compared to DE

Lees (high-solids) cross-flow filtration

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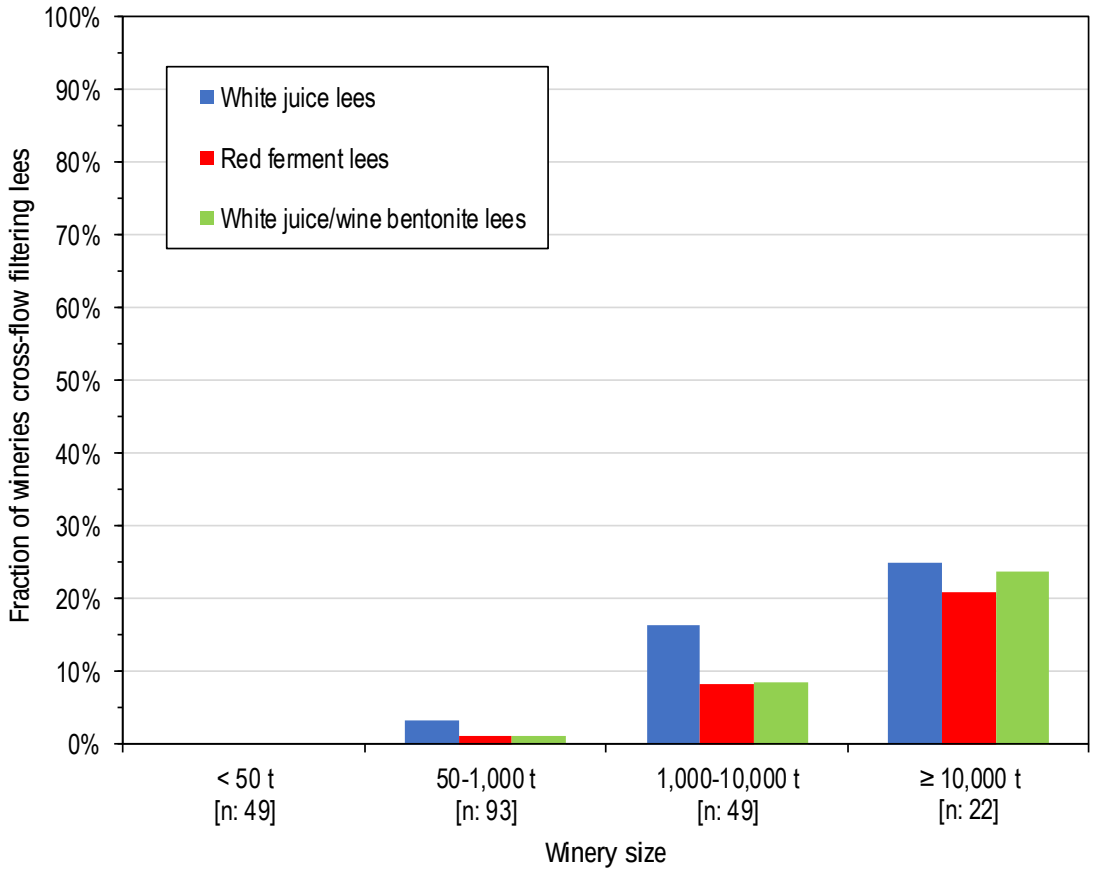

- Helps to avoid oxidation and product dilution common with rotary vacuum drum filters (RVDF)
- Issues with 1-stage lees cross-flow filtration:
  - Low flow rates
  - Ability to genuinely handle really high solids
- Some big wineries using or looking at using pre-clarification of lees by centrifugation or just centrifugation for juice lees

White juice clarification technologies

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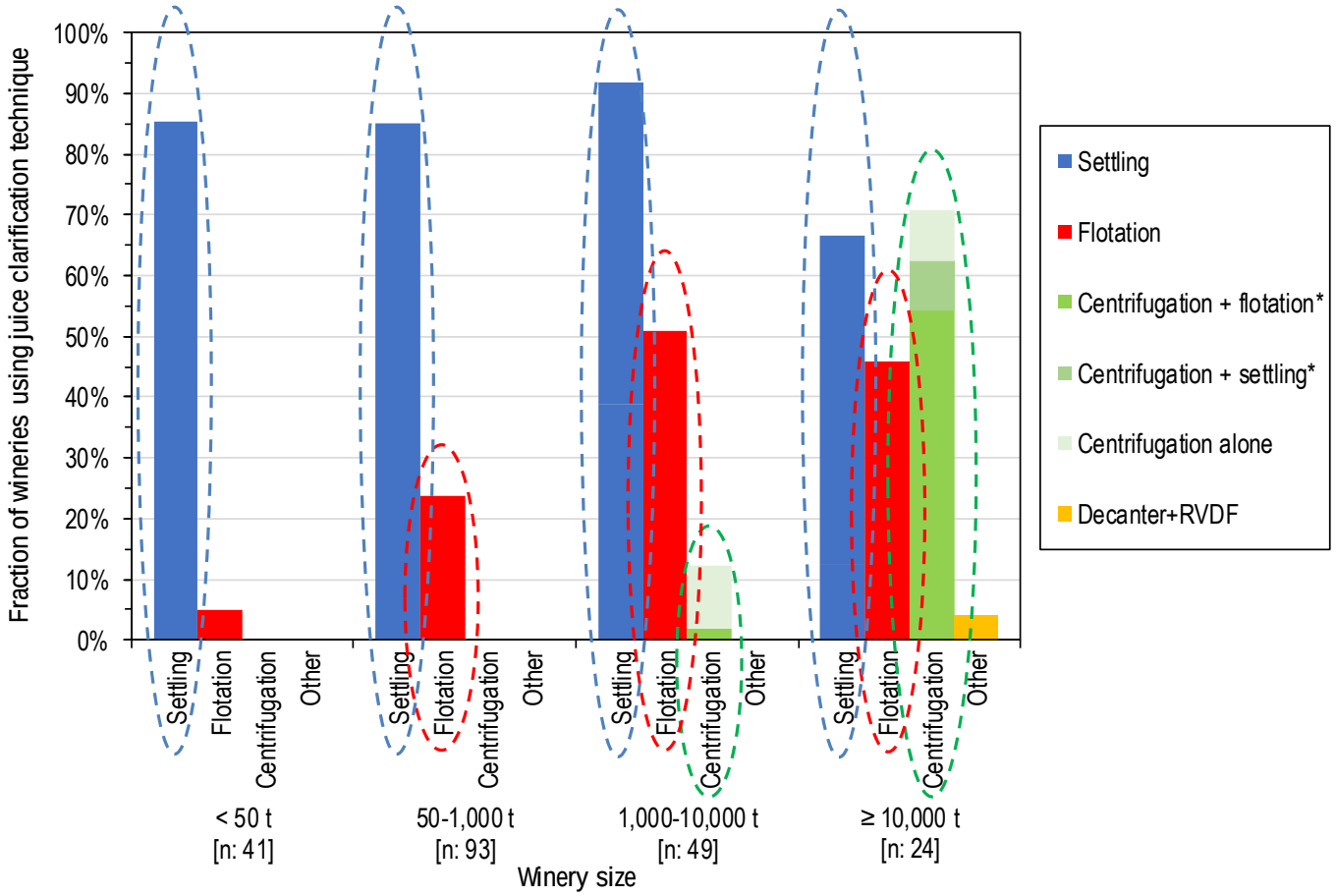

Flotation:

(2nd most important process change nominated)

- Faster than cold settling
- Less cooling required
- Less juice in float lees than cold settled lees
- Batch systems very cheap

*Wineries will not always use the second process – e.g. may skip flotation when clarifying juice for higher solids chardonnay ferments.

Flotation in the wine industry – after centrifugation

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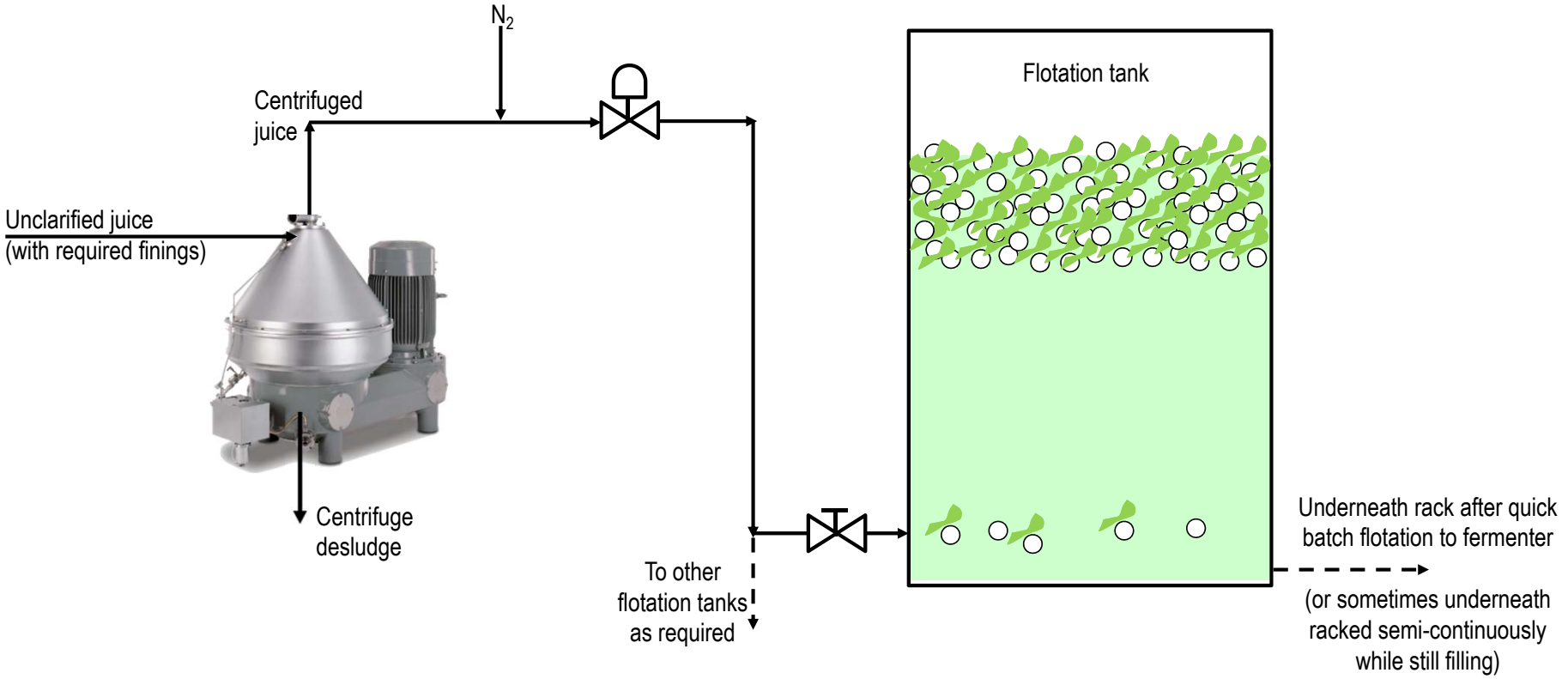

- Flotation post-centrifugation has been used in Australia since at least 1983

(Chan 1984 describes a process similar to above but with N_2 injection in the centrifuge bowl – trying to get definitive references on earliest use)

Flotation in the wine industry – continuous systems

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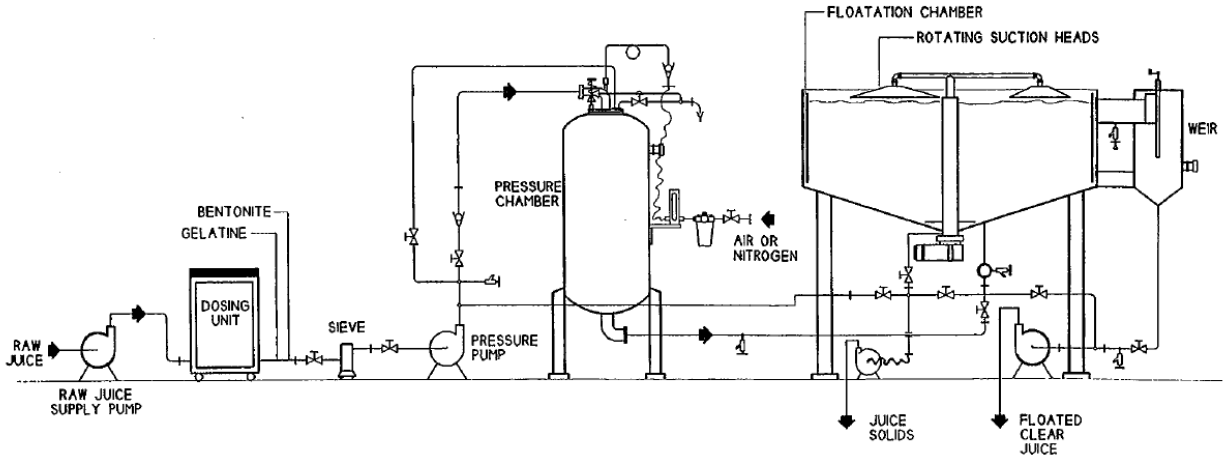
- Early 1990s: many large scale single-stage continuous flotation plants installed around the world, including (only?) one winery in Australia
    - Often used in conjunction with hyperoxidation (appears was popular at the time in Europe)
    - Systems used in conjunction with gelatin & bentonite and sometimes silica-sol & carbon
    - Only suitable for very high throughputs and parcel sizes

Continuous separation basin with rotating suction heads to remove floats – new installation (2017)



Example schematic - Falkenberg (1996) – ASVO proceedings

Flotation in the wine industry – batch systems

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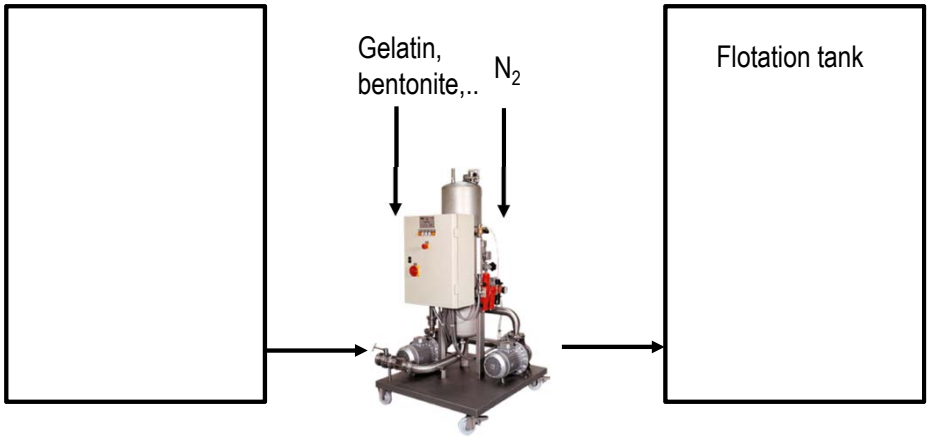
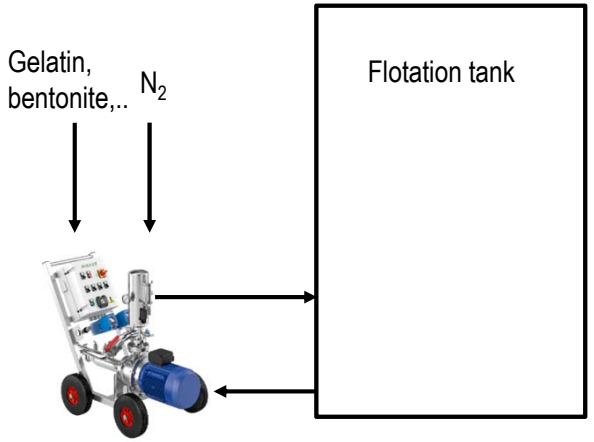
- Compact cheap batch systems that work without large pressure chambers or specialised separation basins appear to have lead to widespread uptake and acceptance of flotation – mainly in last ~7 years
- Smallest recirculation system costs only ~$6,500 and can even use the pump separately outside vintage
- Lots of continuous systems now being installed in large Aust. wineries (because of batch experience?)
- Survey: Nitrogen most common gas used by every survey respondent using flotation

Tank-to-tank operation



Recirculation operation



Only uses 1 tank - just like cold settling (can't fill it as high though)

Heat stabilisation - method

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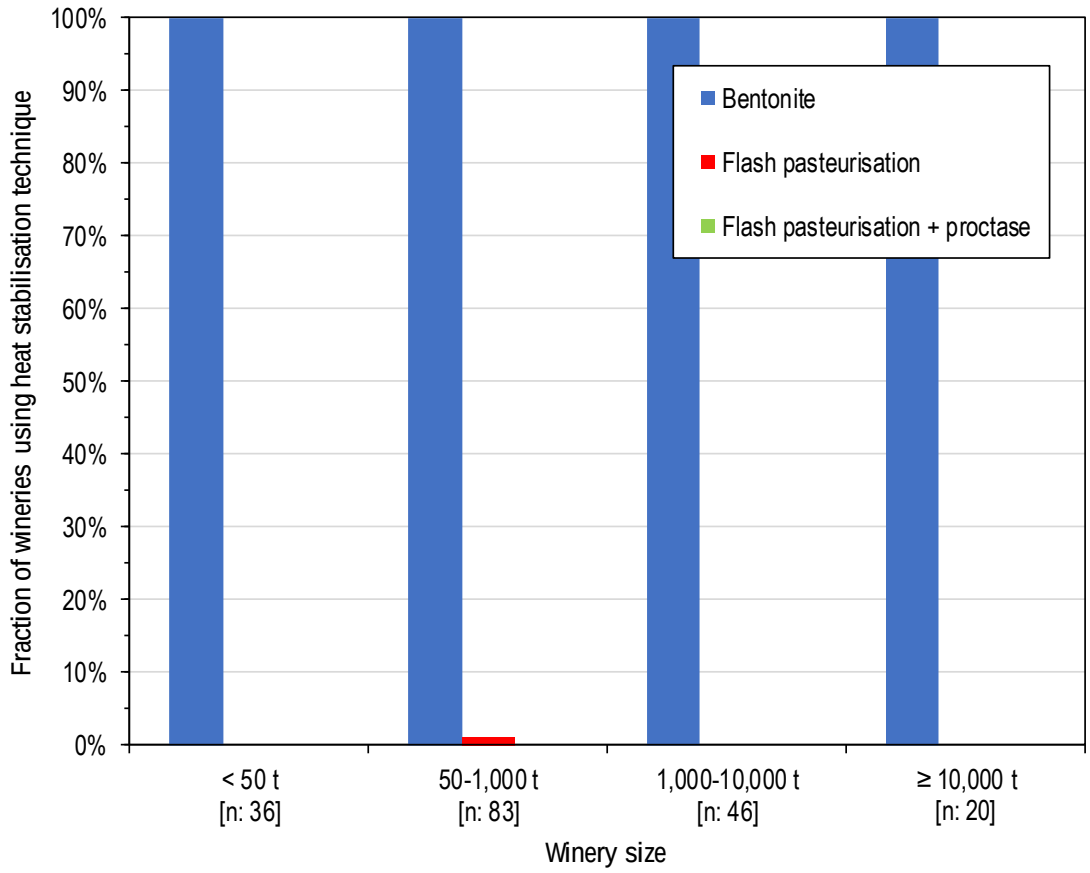

Bentonite:

- Only method really being used for heat stabilisation by industry
- Large lees volumes
  - Juice/wine losses/downgrades
- Possible sensory impacts

Timing of largest bentonite addition

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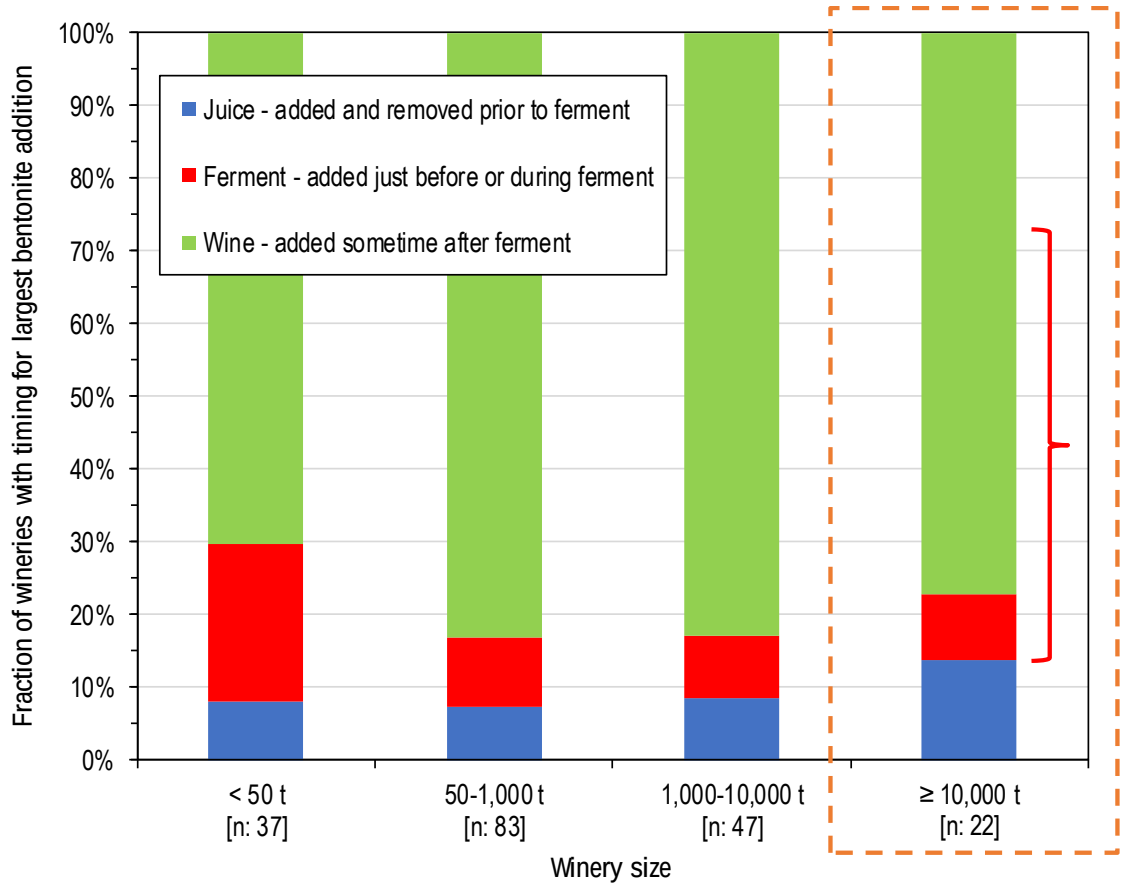

- ~60% of large wineries add and remove bentonite with their gross yeast lees for part of their production (often added post-ferment, sometimes after lees mixing period)
  - Combines steps and possibly reduces overall lees / increases wine clarity
- ~30% of large wineries are using centrifugation during their major bentonite clarification
  - Reduced lees & no need to recover
- ~20% of wineries are in-line dosing bentonite on the way to a centrifuge
  - Combines steps, can rack-fine if desired
- Flotation: Bentonite use during flotation may be having a small effect on bentonite lees volumes across wineries of all sizes? (but need more bentonite if fine at the juice stage)

Most common bentonite type

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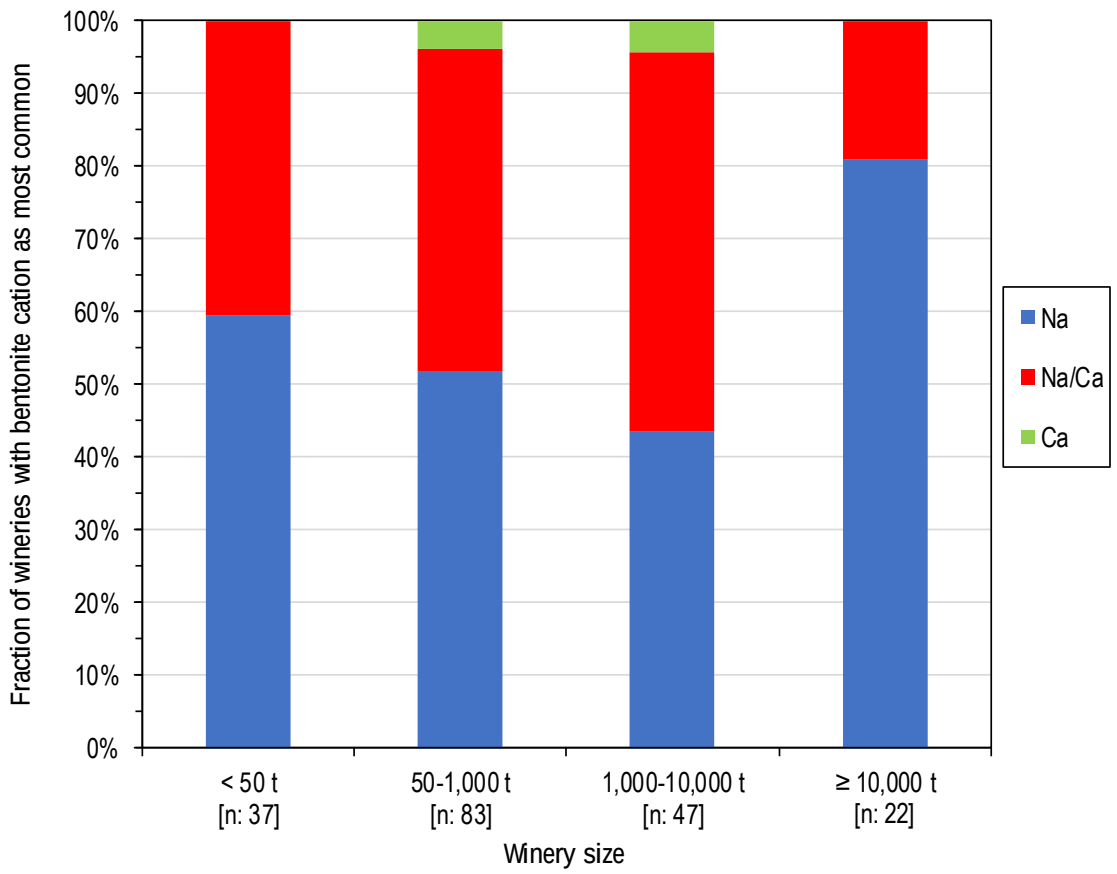

Na-bentonite	Na/Ca-bentonite
Cheaper per kg	Smaller lees
Lower doses	Easier to prepare

- Largest wineries typically use Na-bentonite
  - Cheaper dose for stability and they have lees recovery equipment (RVDF, centrifuges, lees X-flows)
  - But they still sometimes use Na/Ca for smaller volume premium products
- Not captured in the survey explicitly, but there are a lot of flotation specific fining agents being used (e.g. Flottobent, Flottogel, Bent'up, Gel'up)
  - Relative performance? (don't know)

Cold stabilisation methods

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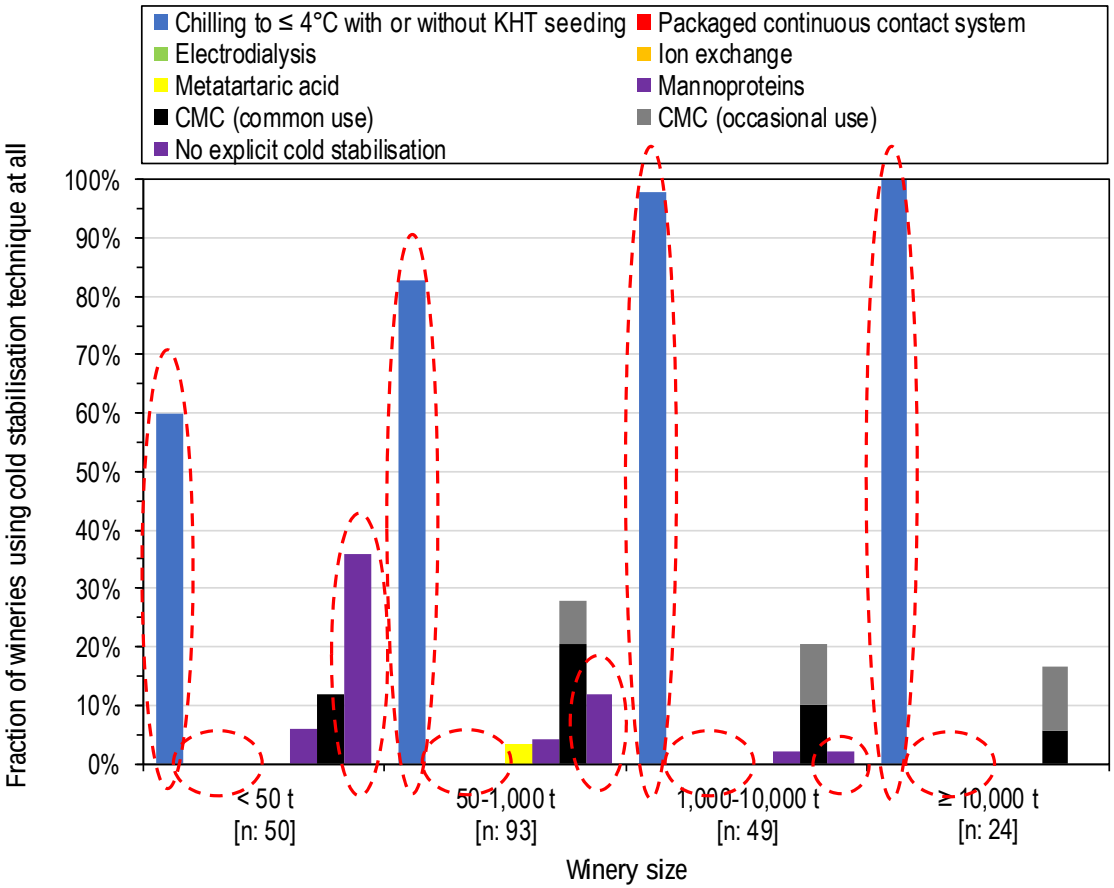
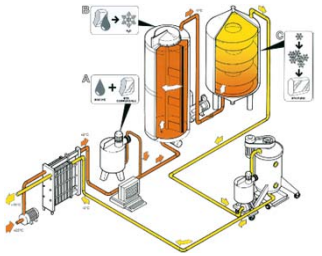
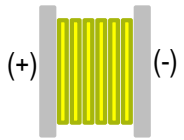


- Chilling with or without KHT seeding is the most common method of cold stabilising in wineries of all sizes
- Smaller wineries do less explicit cold stabilisation because they make more red wine, have higher average price points & longer periods of cold ambient holding pre-bottling (large wineries do similar for their premium reds)
- Packaged continuous contact, electrodialysis and ion exchange not used by any respondent





Cold stabilisation methods – CMC

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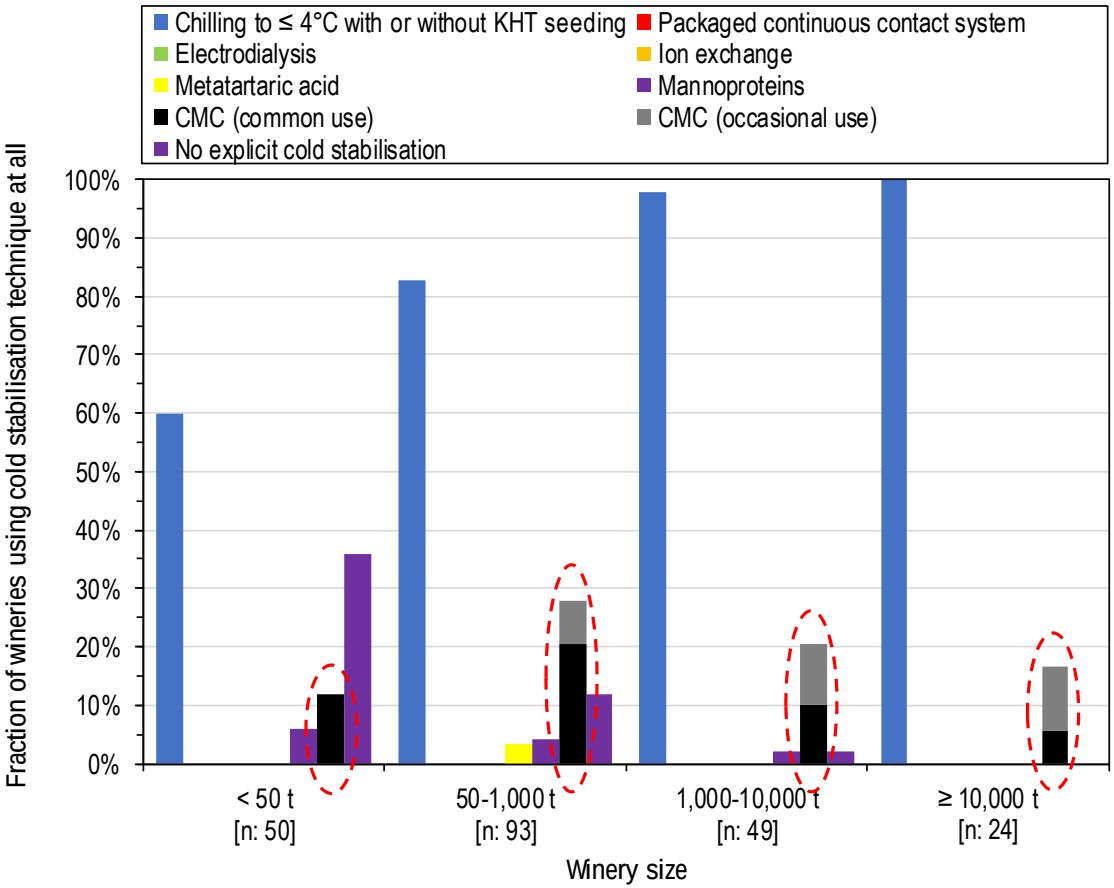

- Promoted as saving cooling/electricity, and being cheap and rapid
  - Current common users seem positive about CMC
- ~20% of wineries using it at all, but only 1 large winery has really adopted as common practice
- Occasional users:
  - Wine needed at short notice
  - Base wines were stable but blend is not
  - Didn't want to drop wine acid with chilling
  - Small white wine volumes
- Wineries not using:
  - Long-term stability questioned
  - Might need to still pre-chill some wines
  - Problems if is later blended
  - Clauses in sales contracts
  - Not allowed in all export markets
  - Filtration concerns
  - Don't mind dropping wine acid
  - Negative sensory impacts of CMC
  - Haven't done sufficient trial work yet

Cold stabilisation methods – Potassium polyaspartate

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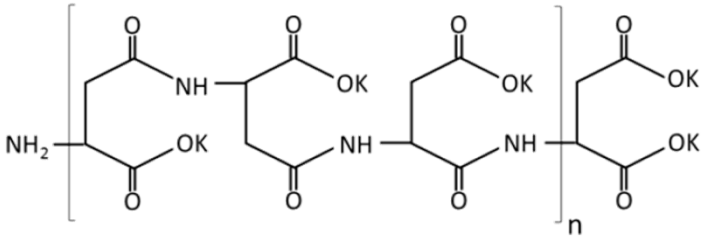
- Crystallisation inhibitor
- Can work in red wine as well as white wine (unlike CMC)
- Easier to prepare and use than CMC (no filterability issues)
- Patented in wine application by Enartis
- Approved by OIV in 2016, but still Undergoing approvals in Australia
- AWRI hopes to establish some commercial proof of performance trials



ZENITH

FOOD STANDARDS Australia New Zealand
Te Mana Kounga Kai – Ahitereiria me Aotearoa

15 May 2018
[46-18]

Administrative Assessment Report – Application A1161

Potassium Polyaspartate as a food additive in wine

Proposed timeframe for assessment:

'Early Bird Notification' due: 10 May 2018

General Procedure:

Commence assessment (clock start)	Mid May 2018
Completion of assessment & preparation of draft food reg measure	Early Aug 2018
Public comment	Mid Aug – End Sep
Board to complete approval	Early Feb 2019
Notification to Forum	Late Feb 2019
Anticipated gazettal if no review requested	End Apr 2019

Labelling considerations – a future challenge

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ceev Comité Européen des Entreprises Vins

European Independent Confederation of Winegrowers

copa*cogeca european farmers european agri-cooperatives

EFOW European Federation of Origin Wines

Detailed wine and aromatised wine products annex
to
The self-regulatory proposal from the european alcoholic beverages sectors on the provision of nutrition information and ingredients

12 MARCH 2018

Appendix I

List of oenological additives that may be included in the list of ingredients[1]

Preservatives		Stabilising Agents	
Potassium sorbate	INS 202	Metatartaric acid	INS 353
Liquid sulfur dioxide	INS 220	Gum arabic	INS 414
Potassium anhydrous sulphite	INS 224	Sodium Carboxymethylcellulose	INS 466
Potassium hydrogen sulphite	INS 228	Yeast mannoproteins	
Ammonium hydrogen sulphite		**Others**	
Ascorbic acid	INS 300	Caramel	INS 150a-d
Lysozyme	INS 1105		

1 Version March 2018.

- Additives may need to be listed on the label (or a QR code?) at some time in the future
  - Not those naturally occurring in wine, or processing aids
  - May still be some time away?

- Additive vs. subtractive approaches to stabilisation?

https://ec.europa.eu/food/sites/food/files/safety/docs/fs_labelling-nutrition_legis_alcohol-self-regulatory-proposal_annex-wine-en.pdf

On-harvester destemming

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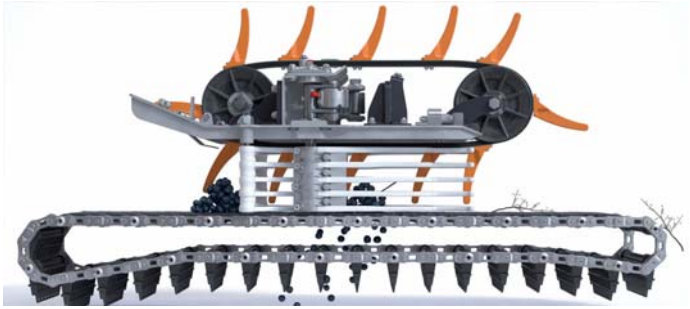
Braud New Holland

Gregoire



Pellenc

Oxbo

ERO

On-harvester destemming (by region)

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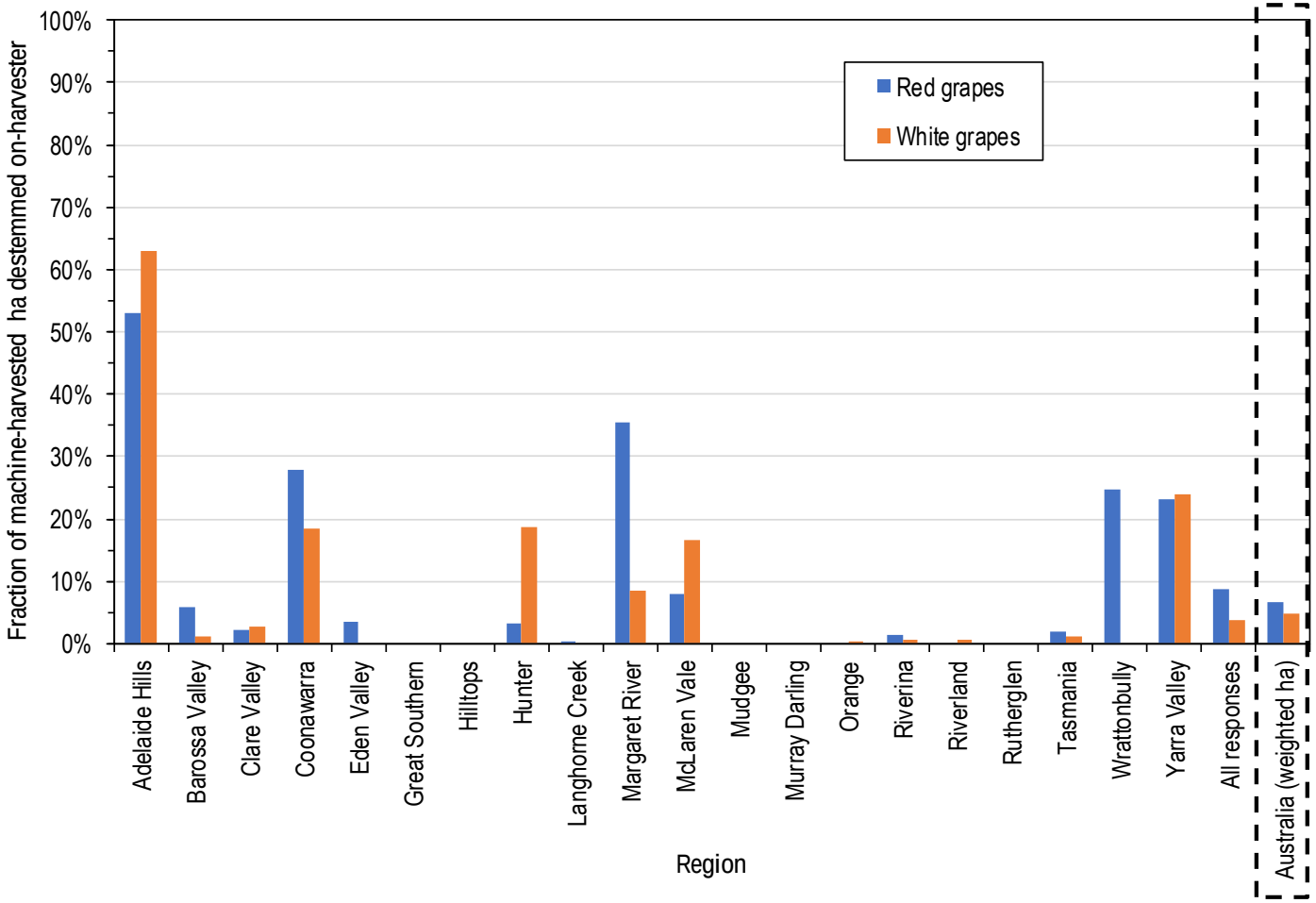

~5%

- Sizeable use of on-harvester destemming (& sorting) in some regions
- Not as big difference in use between red and white grapes as expected (juicing?)

On-harvester destemming – directions

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- Systems increasingly compatible with side-arm discharge conveyors
- Systems more capable of handling higher yielding vineyards?
- Simplification – less maintenance & cleaning issues?

→ Adoption likely to increase (first in premium areas)

Winery destemmer types

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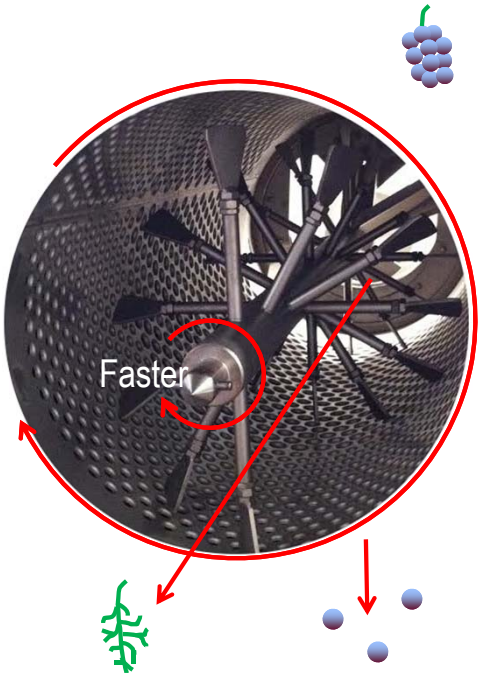
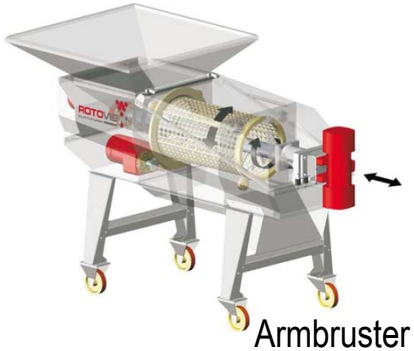


Industry standard rotary destemmer

SOCMA/Scharfenberger, c. 1999
Linear with finger wheels

SOCMA Cube, c. 2010
Shaking rods

Bucher-Vaslin Oscillys,
Shaking cage, c. 2011



Armbruster Rotovib, c. 2006
Shaking rotary beater

Pellenc Selectiv', c. 2008
Shaking rods

Winery destemmer types used (by winery size)

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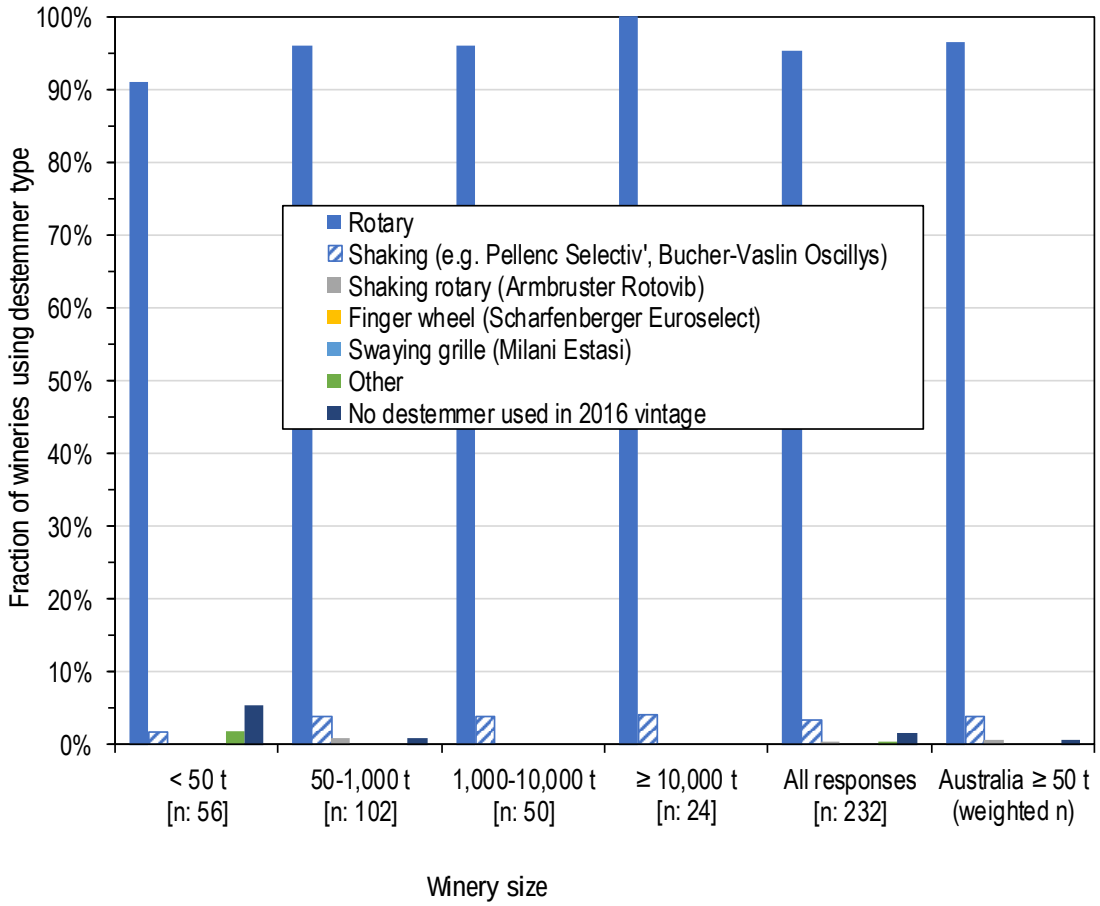

- Rotary destemmers still dominate
- Shaking destemmers only used at 4% of Australian wineries
- Shaking destemmer adoption likely to increase for premium producers
  - More intact berries
  - Include integrated roller sorting
    - Less MOG
  - More expensive
  - Limited throughput capacity

Winery grape sorting technologies

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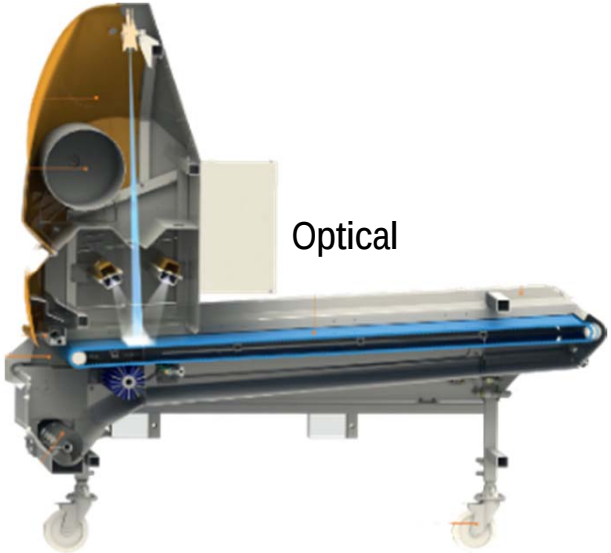
Vibrating

Rollers (often integrated with shaking destemmer)



Optical

Blower

Density bath

Sorting equipment used (by winery size)

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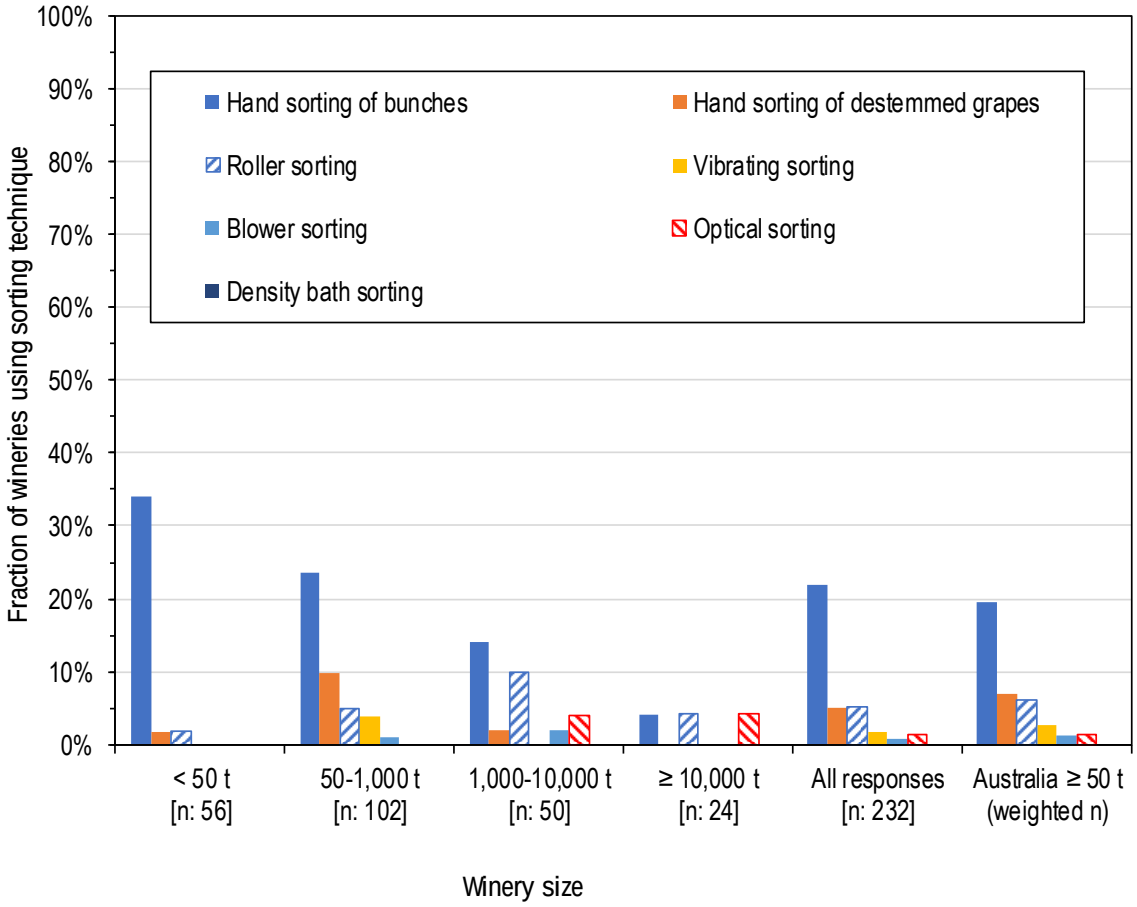

- Hand sorting of bunches is still the most common sorting technique in use
- 6% roller sorting
  - Cheaper
  - Simple
- 1% optical sorting
  - Expensive
  - Flexible

More than one type sometimes used.

Winery sorting – future directions

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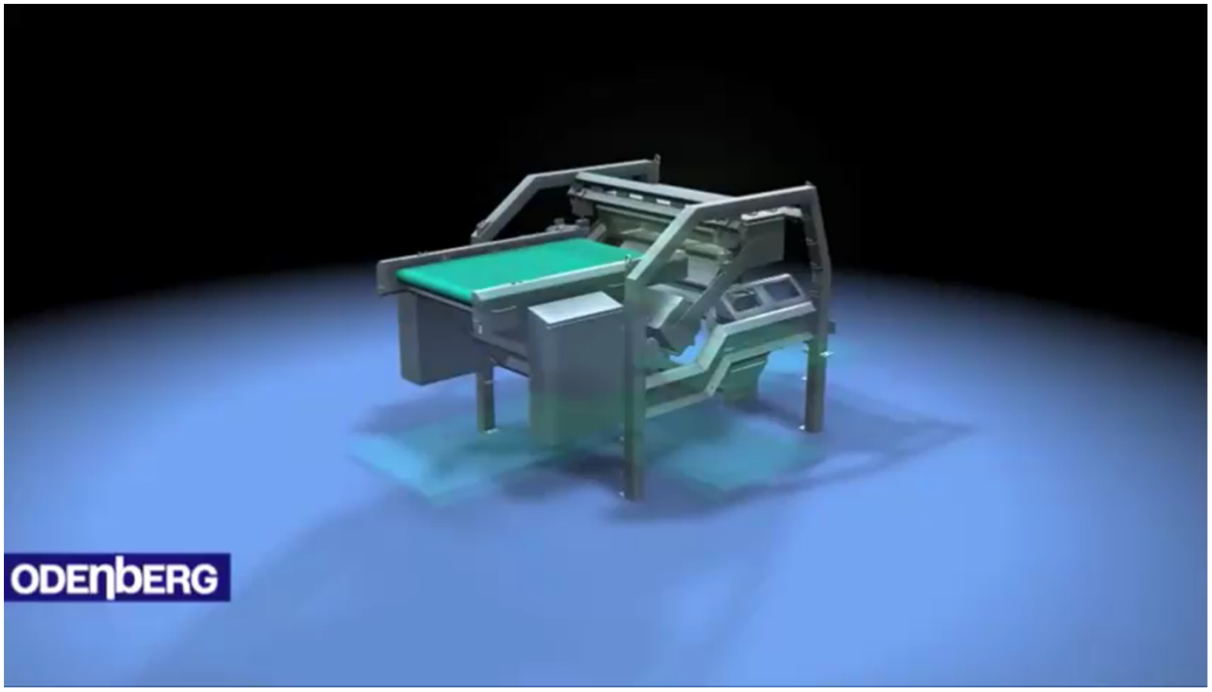

- Optical sorters may be more widely adopted as prices come down and technology improves
- Perhaps ultimately we will be able to divide grapes into multiple fractions by slight differences in sugar

  (instead of just removing the extremes – green & raisined grapes)

White grape pressing equipment (by winery size)

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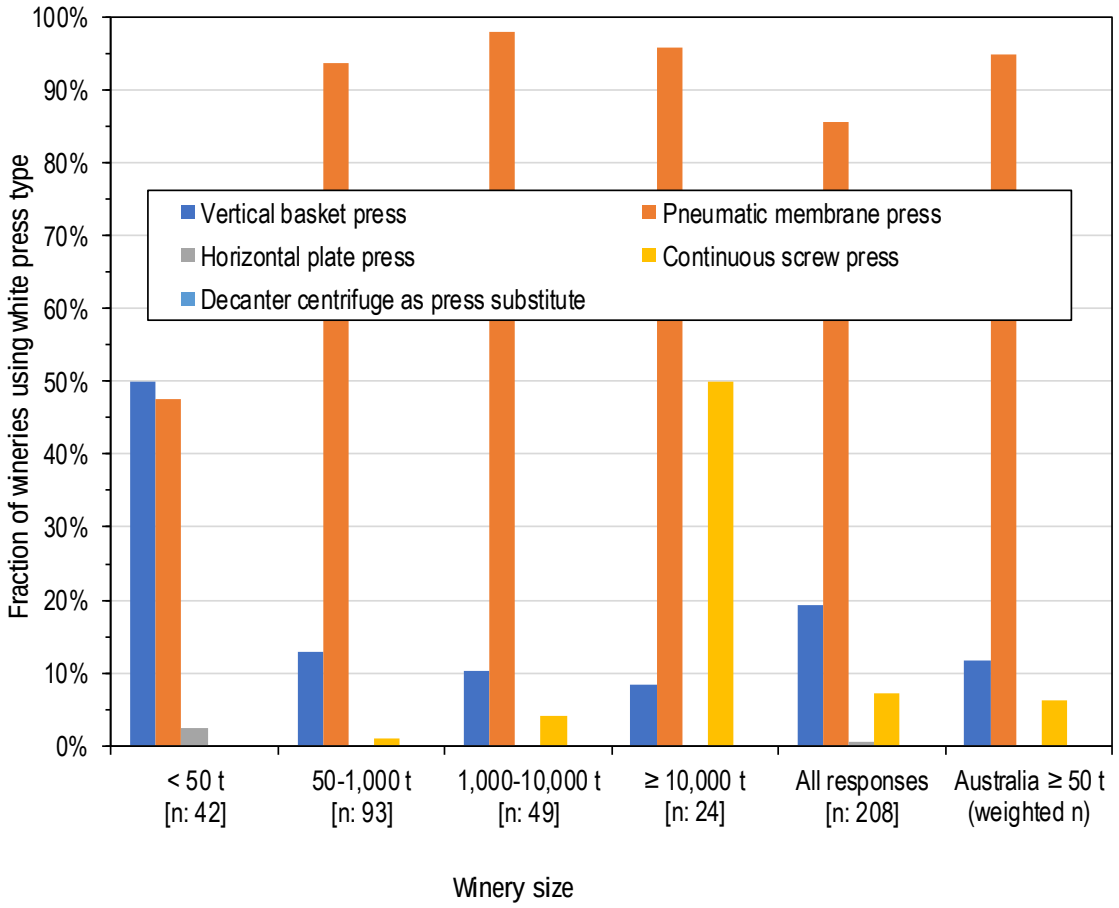


- Membrane press is most common pressing technique

- Lower solids
- Higher quality?
- Lower throughput → many presses

- 95% of wineries ≥ 10,000 t used membrane presses
- 50% of wineries ≥ 10,000 t also used continuous screw presses

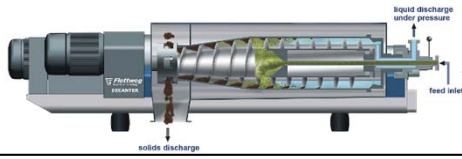
Conventional thinking

UPGRADE OPTIONS?

Status quo

Good or bad idea?

- No respondents were using decanter centrifuges as a press substitute



Decanter summary

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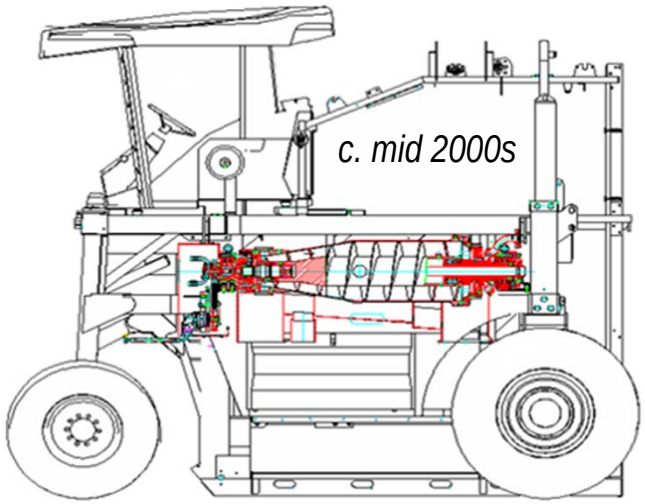
- ~50 worldwide used as press substitutes
- No ability to make press-cuts (all one juice fraction)
- Some supplier suggestions that might be able to avoid additional juice clarification pre-ferment by initially dosing specific gelatin
    - None of the decanter wineries I have visited so far do this
- People that have decanters seem happy with them
- Not new technology, but the only real alternative to membrane/screw presses (for whites) and worth trialling?

- Attempts at juicing with harvester-mounted unit
    - Only for whites
    - New Australian trials last vintage?



Continuous press technologies – red wine

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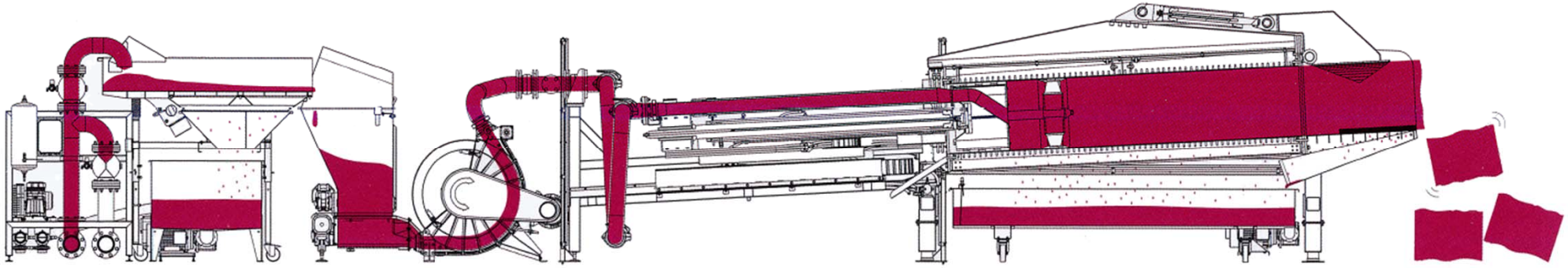
- Diemme QC620 continuous press for red wine (c. 2015)
- No screw, reduced lees
- Not suitable for fresh white grapes
  - No crumbling, so too low yield



1. Vibrating drainer 2. High-pressure peristaltic pump 3. Hydraulic press

Mixing red ferments with compressed air

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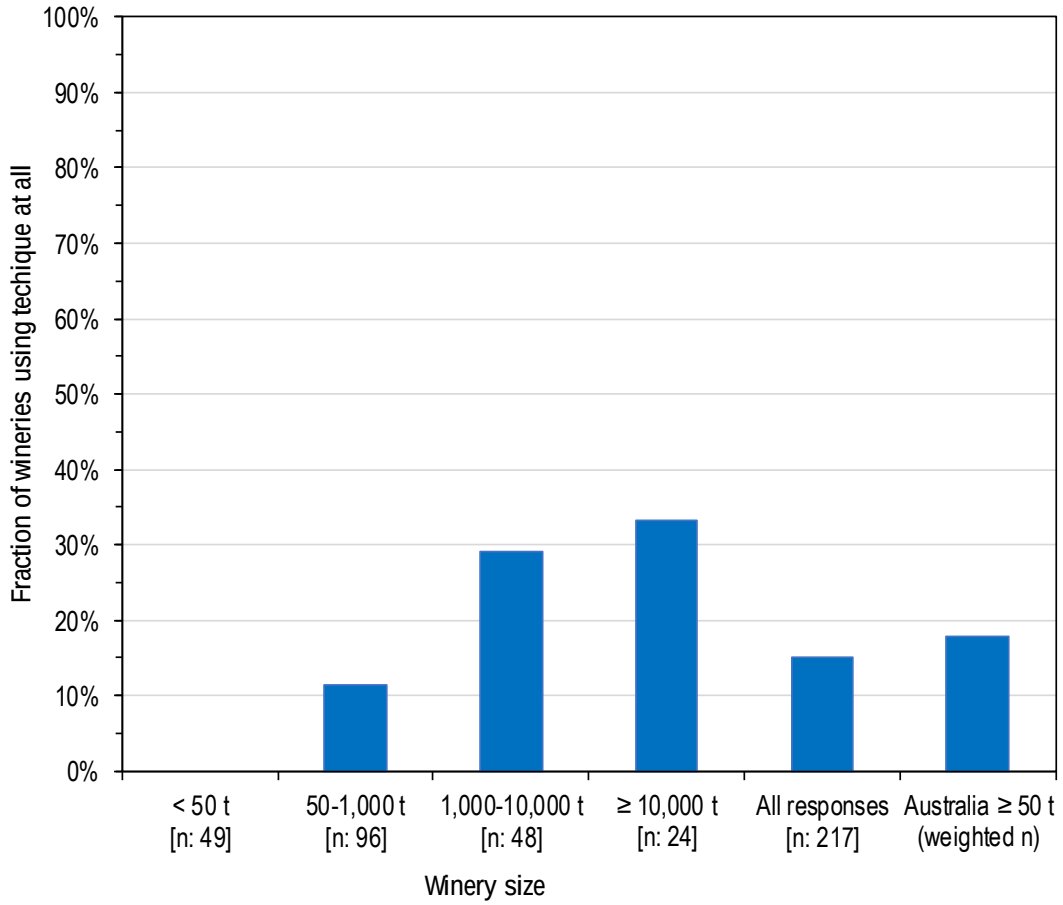

Pulsair®

air miXing®

- People generally quite positive
- Labour savings
- Helping get skins out of tanks

- Use likely to increase?

Thermovinification/MPC/flash détente (by winery size)

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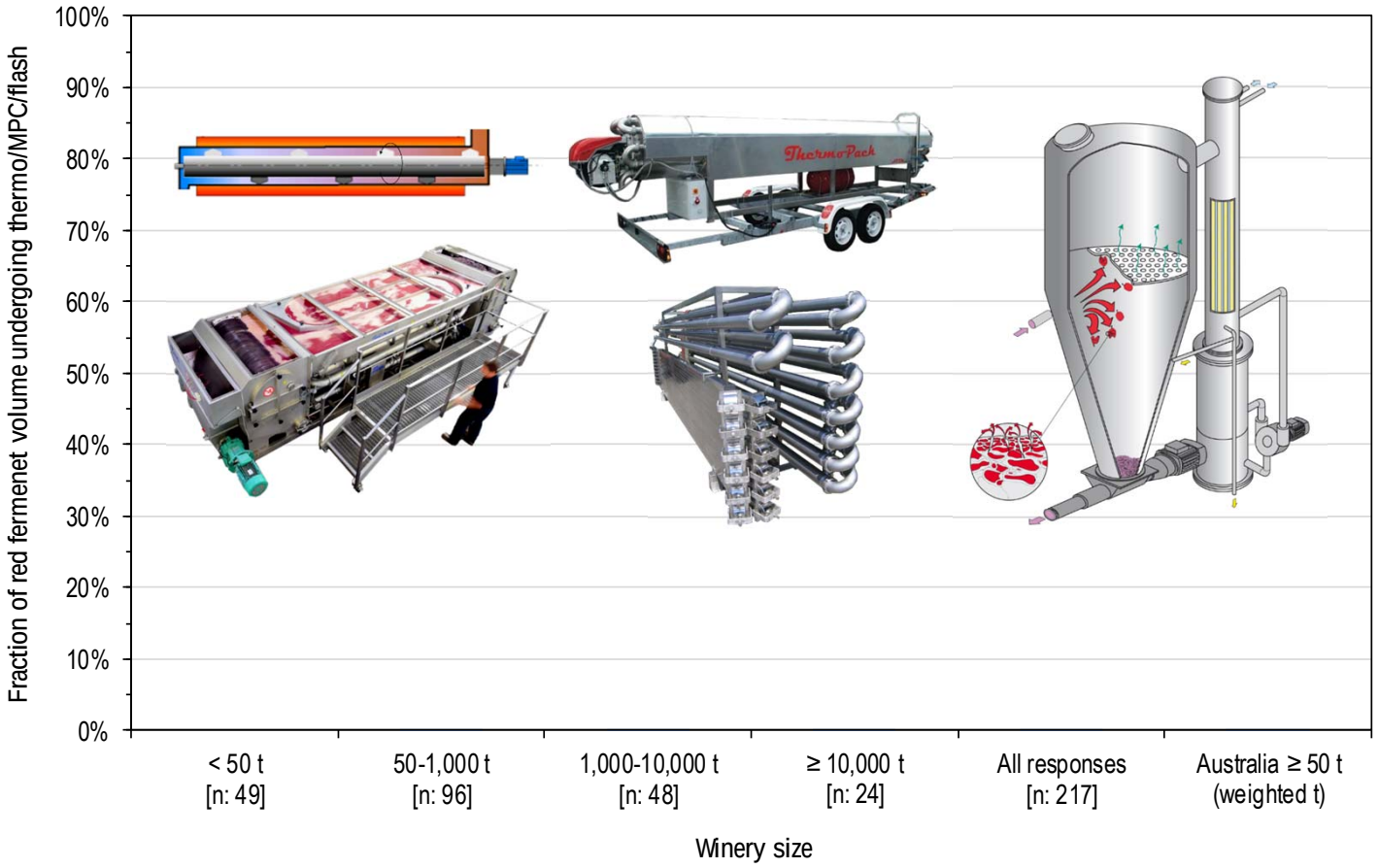

- Negligible thermovinification/ MPC/flash détente being performed by survey respondents
- Only one winery in Australia advertises this as a service on the web
- Not as clear capital justification as Europe where more disease
  - Still could be useful for styles, throughput

Fermentation sensors (by winery size)

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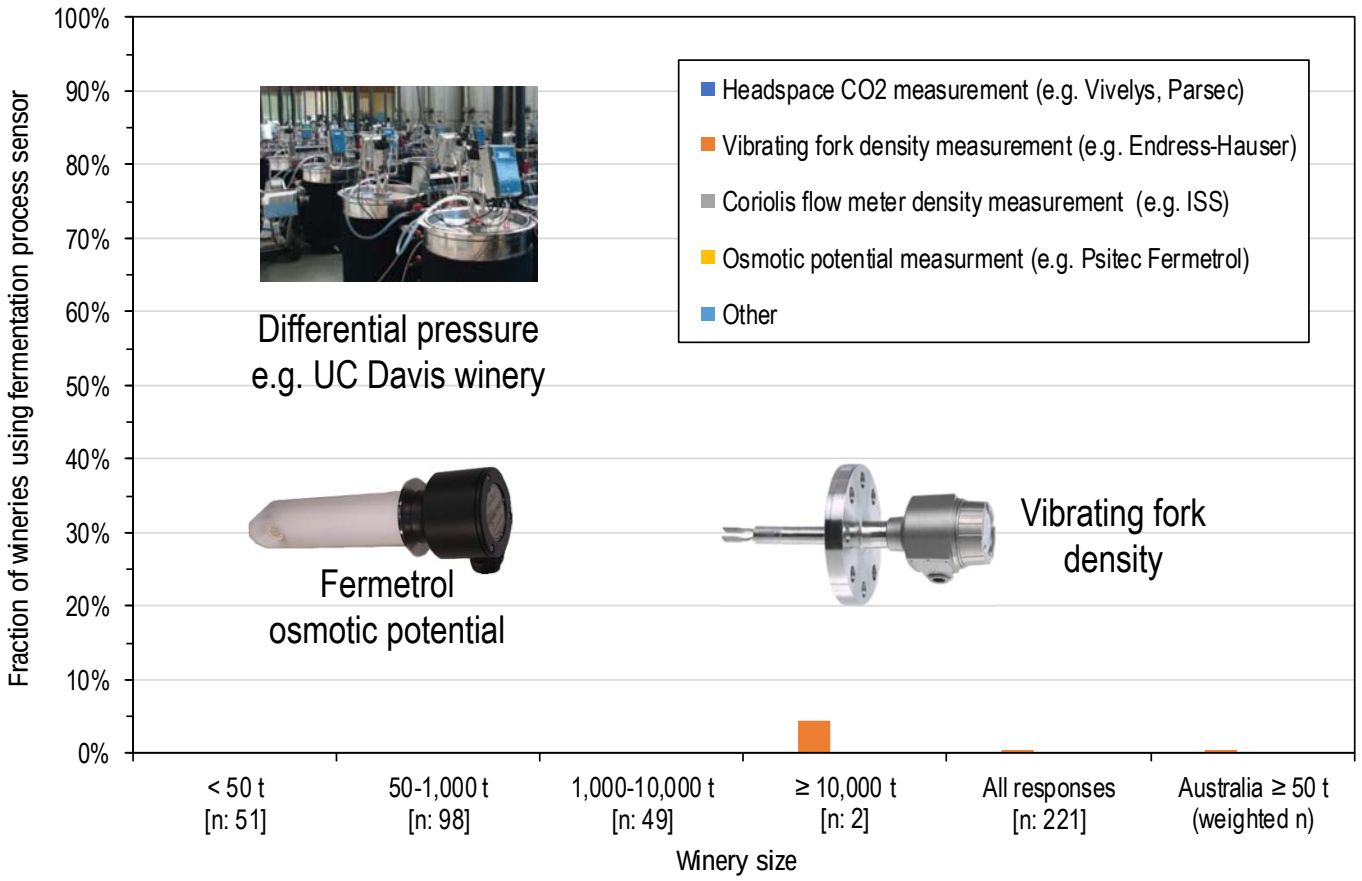

- Only 1 winery using in-tank sensors to monitor sugar conversion to ethanol

Reasons:

- High cost of fitting sensors to multiple tanks
- Difficulties cleaning sensors
- Avoiding fouling by skins, additives, etc.
- Why not just measure in lab, need to collect a sample for sensory anyway

Fermentation sensors – Palmaz Vineyards, Napa

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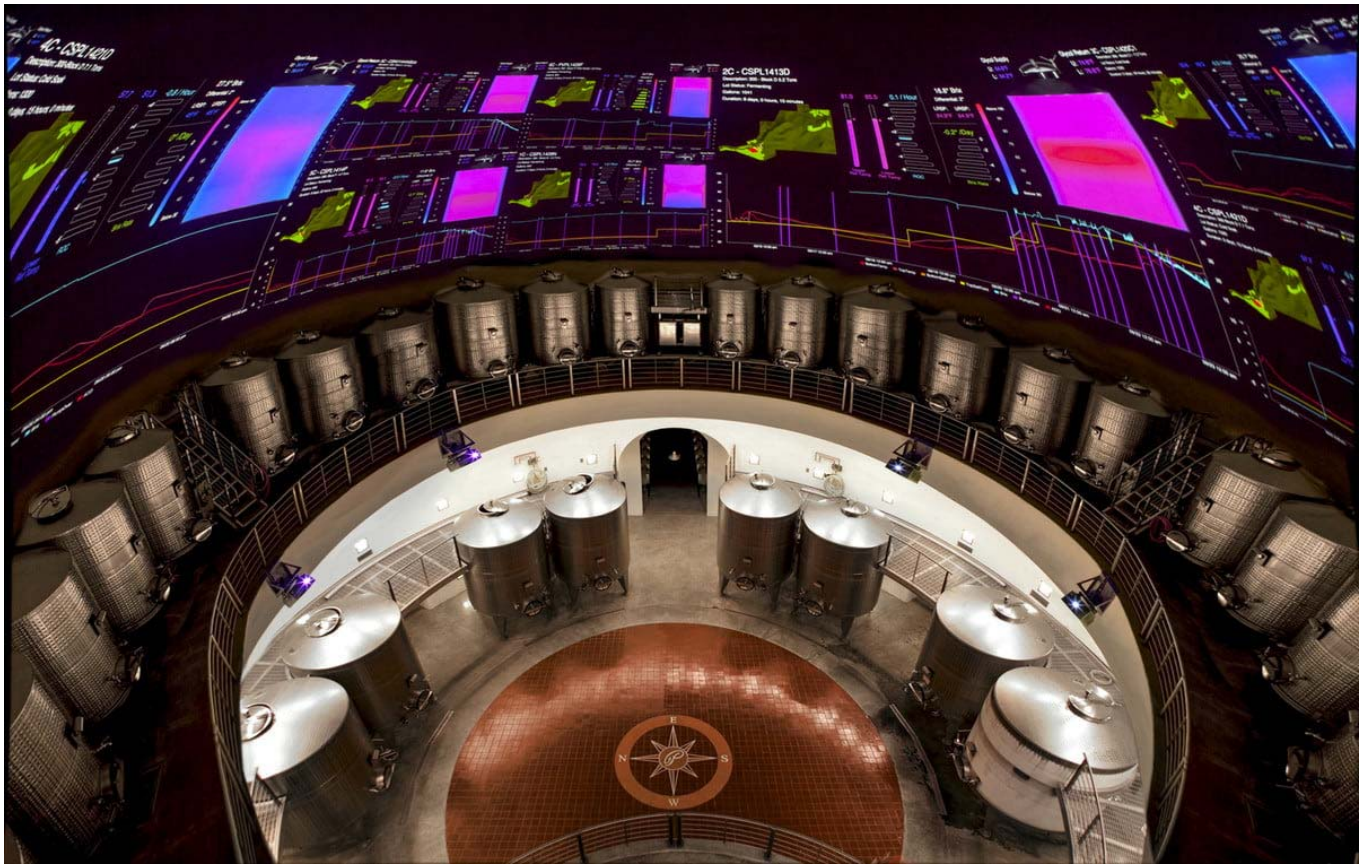

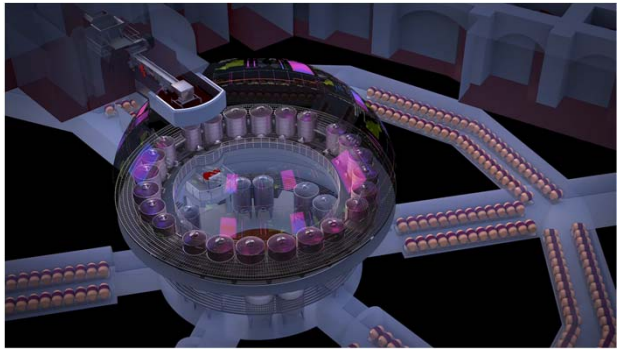

- Vibrating fork density sensors for ferment tracking
- Data visualisation

Using CO_2 flow rate to monitor ferments

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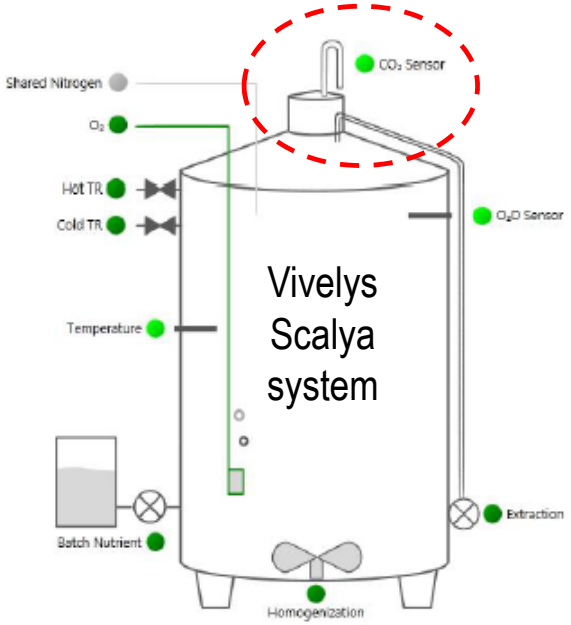
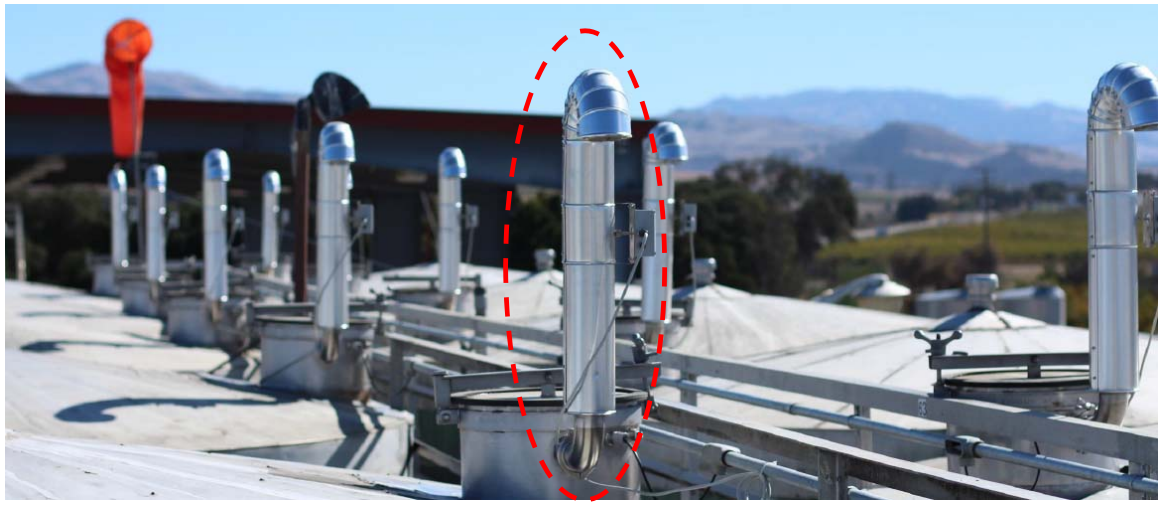
Sugar ⟶ Ethanol + Carbon dioxide

Track ferment by monitoring gas flow rate
(Relatively simple and non-invasive since not in contact with wine)





What do they do with it though?

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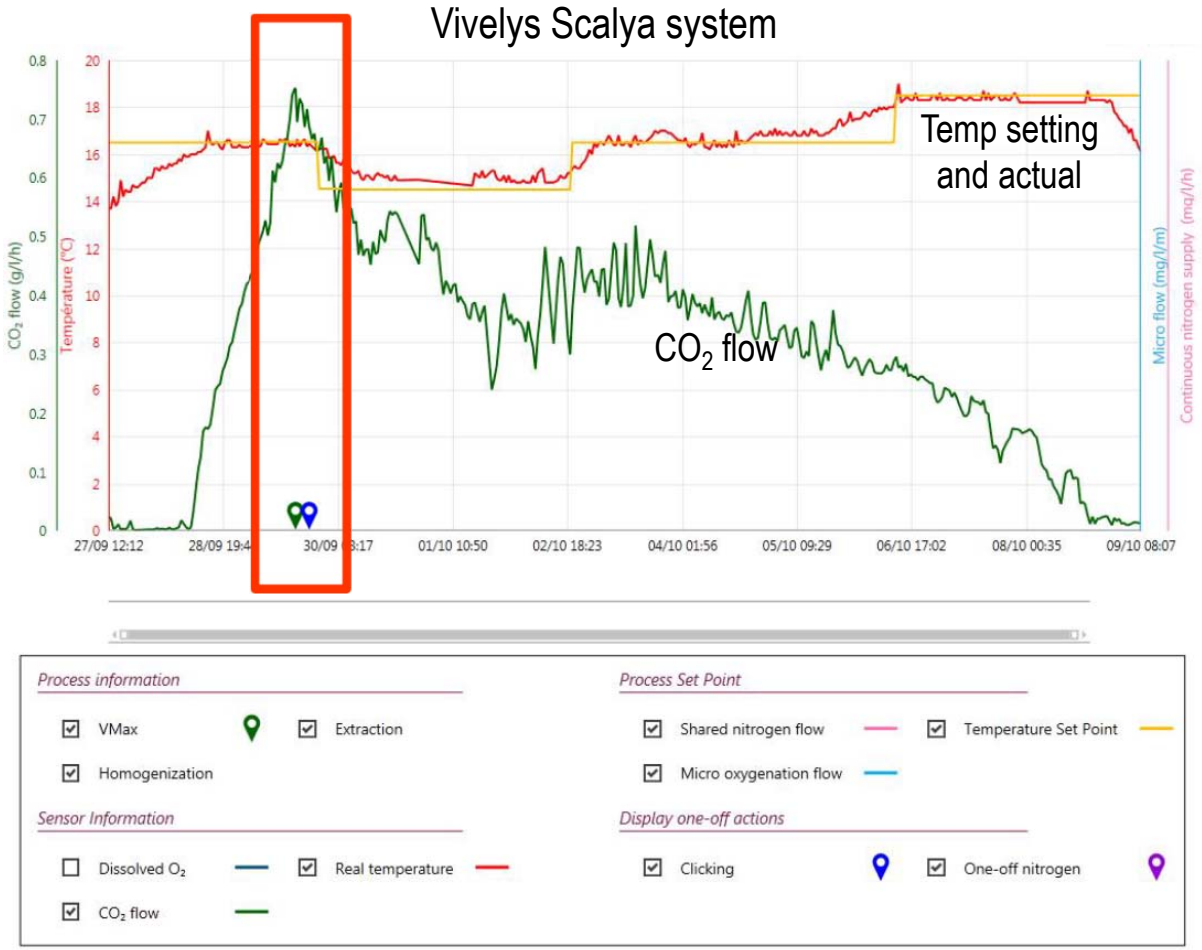

- Automatic oxygen addition at peak CO_2 flow (V_{max})
  - Avoiding sluggish and stuck ferments
  - Faster tank rotation
- Understanding ferments
- Mainly used for white ferments

Ferment process sensors – wine profiles

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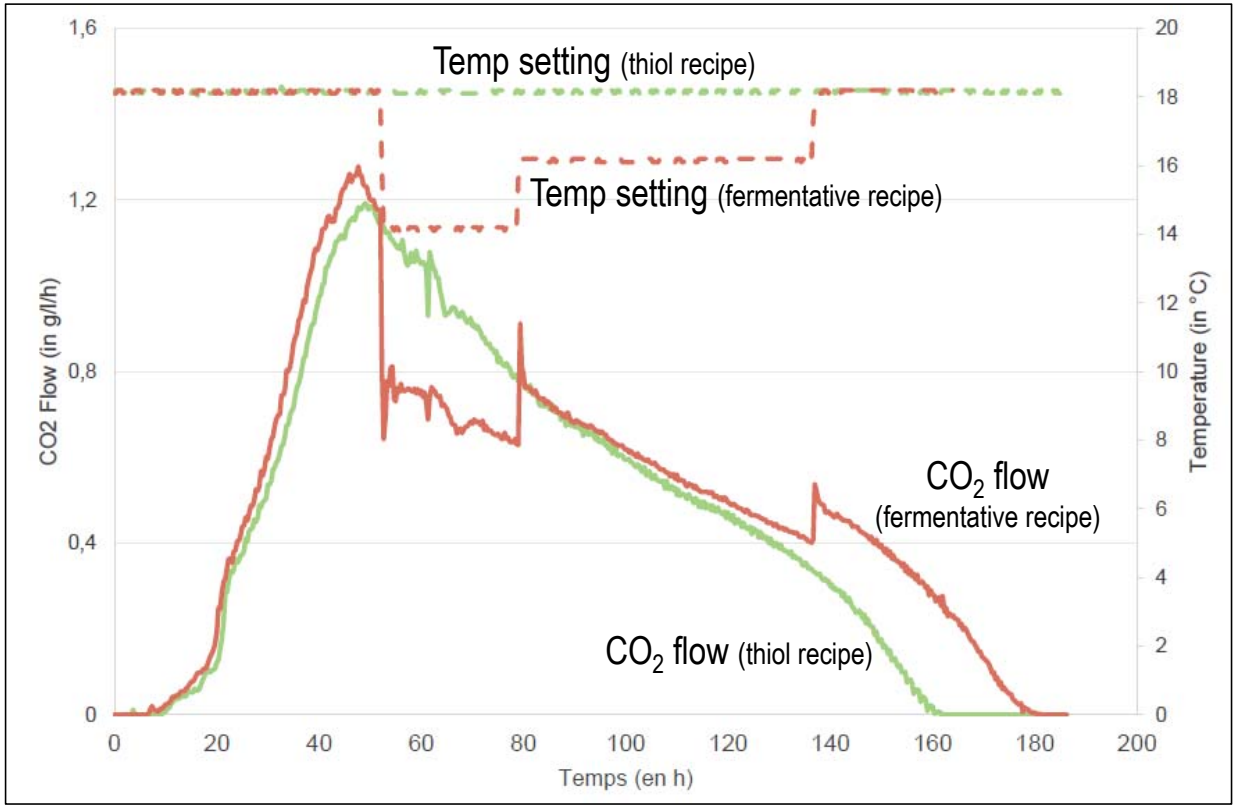
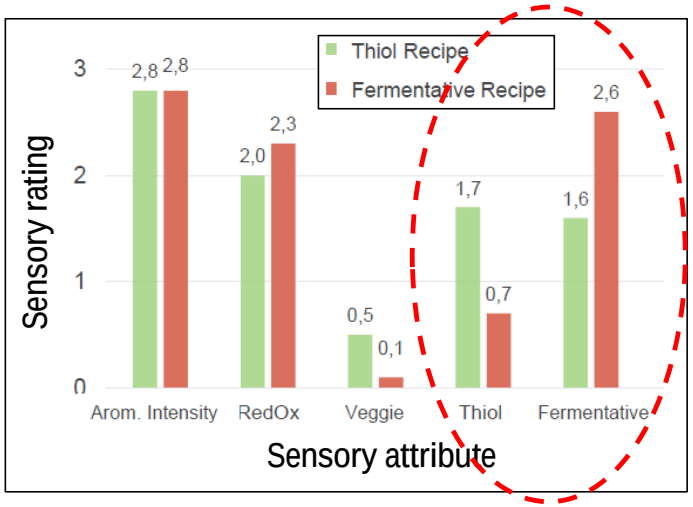
Sauvignon Blanc fermentation with different Vivelys recipes/programs





- Use of CO_2 flow is not essential
- Use of different temps for different ferment profiles already practiced, but
- Really neat, logical automated implementation in targeting wine profiles

Wineries versus other factories

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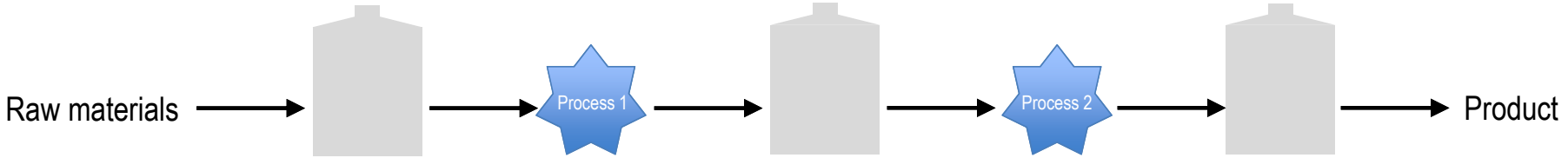
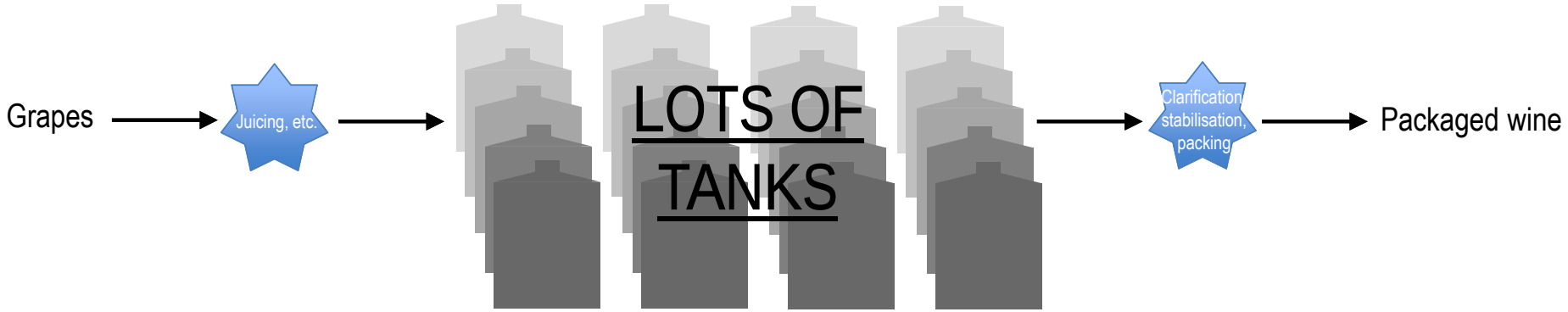
Many other factories

Hold-up time: days-weeks
Activity: all year around



Wineries

Hold-up time: months-years
Activity: concentrated at vintage



The tank – our most important tool?

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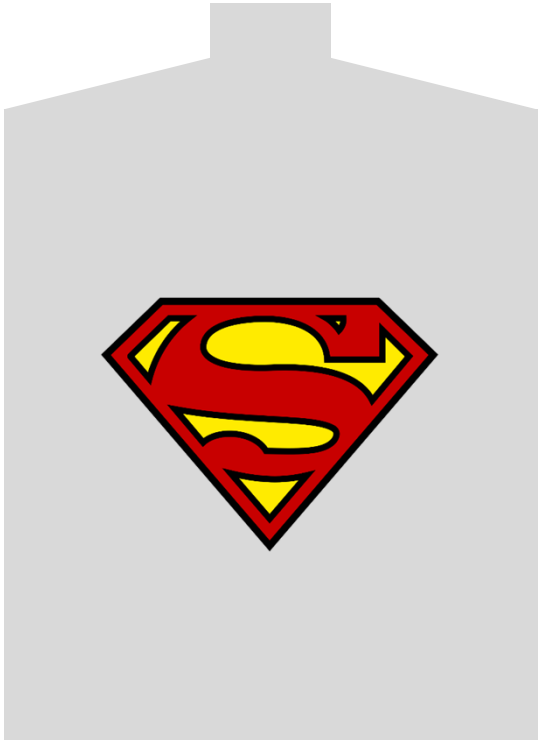
- Since so many tanks it can be hard to justify:
  - Sensors
    - Level
    - Fermentation progress
    - Temperatures at different depths
    - Sulfidic characters
  - Robust ullage management equipment
    - Allow wine to be stored ullaged indefinitely?
  - Tanks that are strong and able to facilitate what we might want to retrofit in their lifetime



A challenge for the future

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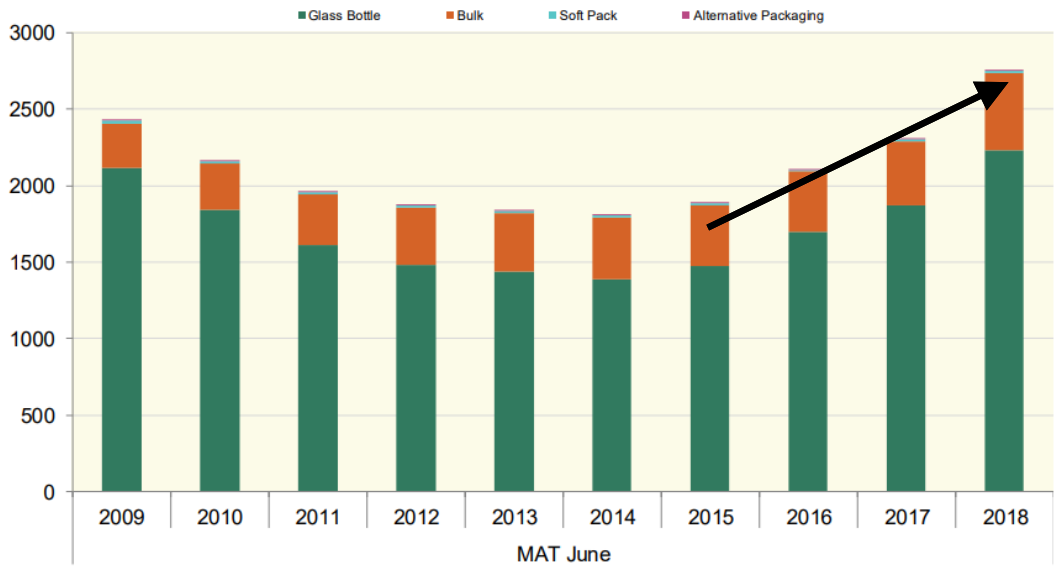
Australian exports in A$ million



- Industry on the rise in Australia?
- Will wineries take the opportunity to invest in more sophisticated tanks or just replicate what they do currently?
- Could it help you better understand your process?
- Could that understanding allow you to increase: quality, price, yield, consistency?
- Could it help you optimise styles & in new product development?

Acknowledgements

- Grape and wine producers who filled out the survey and allowed me to visit/phone
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Disclaimer

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The information contained in these slides should be considered general in nature, and viewers should undertake their own specific investigations before purchasing equipment or making major process changes.

None of the information presented in this article should be considered as an endorsement or dis-endorsement of any product by the AWRI.